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Alien species — environment, biorisks, future

Introduction

This special issue of *Boreal Environment Research* deals with alien species and their role in ecosystems now and in future. Alien species are affecting ecosystems worldwide, and, following habitat destruction, they are considered the second largest threat to biodiversity in both aquatic and terrestrial ecosystems. The cold climate of northern latitudes has offered boreal ecosystems some protection against the invasion of many harmful species. However, global warming may well enhance the survival of novel aliens in high latitudes. Also the expanding global trade increases the risk of new introductions, calling for improved control in transportation. The economic impacts of alien species in e.g. agriculture and forestry are enormous and will continue to increase in the future.

The papers in this issue were presented at the Maj and Tor Nessling Foundation symposium '*Alien species — environment, biorisks, future*' in January 2007 (symposium homepage: http://www.nessling.fi/symposiot/2007/). The symposium was organized in collaboration with University of Turku and Åbo Akademi University. The organizing committee included conveners prof. Erkki Korpimäki (University of Turku) and Dr. Mikael Nordström (Metsähallitus), symposium secretary dr. Pälvi Salo (University of Turku), the representative of the Nessling Foundation doc. Laura Höijer and the scientific committee prof. Jarkko Hantula (Finnish Forest Research Institute), prof. Erkki Leppäkoski (Åbo Akademi University), prof. Pekka Niemelä (University of Joensuu) and doc. Petri Nummi (University of Helsinki).

The objective of the symposium was to provide a forum for a multi- and interdisciplinary discussions of threats and benefits related to alien species: impacts on biotic communities in aquatic and terrestial ecosystems, the economic effects of aliens, the effect of climate change and global trade on aliens, biorisks brought by aliens, and visions for the future. To our knowledge this was the first alien species symposium in the Baltic Sea area with such a wide approach.

At the end of the symposium, Erkki Korpimäki, Mikael Nordström, Erkki Leppäkoski and Pekka Niemelä presented some preliminary conclusions. Based on the active discussion with the audience, the conclusions were modified. The final symposium conclusions are presented below.

Conclusions of the symposium

Alien species are considered as one of the main factors causing biodiversity loss in both terrestrial and aquatic ecosystems. However, most evidence consists of observations that alien species invade and native species decline more or less synchronously, which does not conclusively show that alien species are the principal factor of environmental change. Therefore, experimental approach is needed to answer the question whether alien species are the "drivers", i.e. a major force of ecological changes, or whether alien species are merely "passengers" who take advantage of ecosystem changes, such as habitat disturbance, caused by human activity (Didham *et al*. 2005).

The answer to this question has great conservation value. To prevent any additional species from becoming extinct we must be able to identify the real causes of population declines, not only to treat the symptoms but the disease itself. Alien species may have significant ecological, economic and even social impacts on ecosystems and human societies. Together with other major changes like global

warming, their impact may be even more wide-spread and serious. Research on the biology, distribution and impacts of alien species is needed to be implemented by authorities, NGO's and managers fighting against harmful aliens. This therefore is a field where multidisciplinary research is recommended and important as well as the collaboration between academic and non-academic institutions.

We attempted to evaluate the main outcomes of the symposium in the light of this driver-passenger framework. We agreed that alien predators have clearly been shown to cause major changes in the ecosystems and communities of their new environment (*see* Salo *et al*. 2007 for a review). Therefore, they can be considered as drivers of the ecological change. The case of alien herbivores is perhaps not so clear, but they also have been shown to have major impacts on native communities (Donlan *et al*. 2002) and can thus be considered as drivers rather than passengers. Alien plants are showing characteristics of both drivers and passengers: in many cases alien plants seem to depend on human-modified environments, and are thus not affecting undisturbed communities. On the other hand, some species are able to invade pristine habitats and cause changes in the local ecosystems.

In the cases of alien soil organisms and pathogens it is clear that there is not enough information to make any conclusive judgements. Soil organisms and their interactions, whether alien or native, are still very poorly known. The same holds for alien pathogens, although there is much research going on as far as their impacts are of concern to our well-being.

Overall, we find that the effects of alien species are complex, indeed. The complexity of the target food web and the number of other alien species already present in the system make the effects of new alien invasions even less predictable. In practice, this may mean that each case should be evaluated separately in order to find a targeted and successful management of the problem. Therefore, there is a plethora of needs and opportunities for the future research into invasion biology which include:

1. opportunities to study rapid evolutionary processes possibly induced by alien species invasions,
2. establishment of landscape-level long-term experiments to tease out the impacts of different agents,
3. new insight into biogeography (patterns of invasions, vectors, invasion corridors),
4. application of modern methods, e.g. molecular genetics, to track the origin of invasive species and their pathways, and hybridisation processes,
5. involving not only biological and ecological but also technical and socio-economic aspects of alien species on the multidisciplinary biodiversity research agenda, and
6. possible biorisks and biosecurity problems caused by alien species, and how these will be affected by, for example, the global climate change and other major drivers of bioinvasions (trade, transport, and travel), which are and will continue to increase as a byproduct of globalization.

Laura Höijer, Erkki Korpimäki, Erkki Leppäkoski, Pekka Niemelä, Mikael Nordström and Pälvi Salo
Members of the Organising Committee

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